

TECHNICAL MEMORANDUM

CONFAC DETERMINATION FOR POST-PROCESSOR

How CONFAC is used in the ARC Model Set

ARC's model set, which consists of the travel demand model and emissions post-processor, was used to develop the motor vehicle emissions budgets for the 2004 State Implementation Plan (SIP). The entire model set has been calibrated and validated to 1990-vintage data. To effectively determine the motor vehicle emission budgets for the 2004 SIP, it was necessary to incorporate recently collected speed data into the emissions estimation procedure.

One parameter used throughout the model set to estimate travel speeds, in particular within the assignment procedure and the emissions post-processor, is the CONFAC, or peak conversion factor. After a 24-hour daily assignment is run, the travel model is run three times for the following peak periods: a three-hour morning peak (AM; 6:30 AM -9:30 AM), a three-hour evening peak (PM; 4:00 PM – 7:00 PM), and an 18-hour off-peak (OP; 12:00 Midnight – 6:30 AM, 9:30 AM – 4:00 PM, and 7:00 PM – 12:00 Midnight). The CONFAC represents the percent of peak period volumes that are in the maximum peak-hour for each peak period. Within the ARC model set, the CONFAC is 0.50 for the AM and PM peak periods and 0.10 for the off-peak period. For example, if a roadway has 1,000 vehicles assigned to it for the AM peak period, 500 would be in the AM peak hour and 250 would be assigned to each of the two peak shoulders. A peak shoulder is a period of time within the peak period, but on each side of the peak hour.

Reason to Change CONFAC

In the calibration of the ARC model in the early-mid-1990's the CONFAC values were initially calculated using the 1990 household travel survey (0.46-0.47 peak, 0.06 off-peak). These values were adjusted to produce model speeds that matched observed speeds in the peak periods and match volumes in the off-peak period. The AM and PM peaks were adjusted to 0.50 and off-peak was adjusted to 0.10.

Since the emissions post-processor will incorporate new parameters to reflect newer speed study data, it was essential to determine an updated CONFAC to represent today's travel patterns and peak spreading phenomenon.

CONFAC Calculation Methodology

Instead of determining the CONFAC by calibrating congested-modeled speeds to observed speeds and to match off-peak volumes, observed traffic flows were used to update the CONFACs within the emissions post-processor.

A database of official quality-controlled traffic counts conducted by the Georgia Department of Transportation in 1999 was used as the basis to develop updated

CONFACs. The database consisted of hourly counts with 3,414 records in the 13-county nonattainment area.

The am peak, pm peak, and off-peak period volumes and maximum peak hour volumes within each period were determined by functional classification, using queries on the GDOT database. The data from the queries, which reported the hourly volume by time-of-day and by functional classification, were then broken down into the three peak periods and the maximum peak hours within each period was calculated. The summarized results of the analyses are shown in Tables 1 (AM), Table 2 (PM), and Table 3 (OP).

Table 1. AM Peak Period Summary

Functional Class	N	Peak Hour	% AM Pk Hr	% AM Pk Per	CONFAC
01 RurInterstate	156	7:00 - 8:00 AM	5.8%	15.6%	0.370
02 RurPrArt	62	7:00 - 8:00 AM	7.5%	18.8%	0.397
06 RurMinArt	86	8:30 - 9:30 AM	7.1%	18.6%	0.380
07 RurMajColl	225	7:00 - 8:00 AM	7.7%	19.1%	0.402
08 RurMinColl	15	7:00 - 8:00 AM	8.9%	20.8%	0.427
09 RurLocal	38	7:00 - 8:00 AM	7.4%	18.3%	0.407
11 UrbInterstate	154	7:00 - 8:00 AM	6.3%	16.5%	0.382
12 UrbFrwy	108	7:00 - 8:00 AM	6.0%	16.7%	0.357
14 UrbPrArt	511	7:00 - 8:00 AM	7.1%	18.7%	0.380
16 UrbMinArt	658	7:00 - 8:00 AM	7.3%	18.6%	0.392
17 UrbColl	924	7:00 - 8:00 AM	6.9%	17.9%	0.385
19 UrbLocal	477	7:00 - 8:00 AM	8.0%	19.6%	0.405

Table 2. PM Peak Period Summary

Functional Class	N	Peak Hour	% PM Pk Hr	% PM Pk Per	CONFAC
01 RurInterstate	156	5:00 - 6:00 PM	7.5%	21.1%	0.354
02 RurPrArt	62	5:00 - 6:00 PM	8.2%	22.8%	0.362
06 RurMinArt	86	5:00 - 6:00 PM	8.0%	22.4%	0.360
07 RurMajColl	225	5:00 - 6:00 PM	8.6%	23.3%	0.369
08 RurMinColl	15	5:00 - 6:00 PM	8.9%	23.1%	0.384
09 RurLocal	38	5:00 - 6:00 PM	8.9%	24.7%	0.360
11 UrbInterstate	154	5:00 - 6:00 PM	7.6%	21.2%	0.357
12 UrbFrwy	108	4:00 - 5:00 PM	7.1%	20.4%	0.348
14 UrbPrArt	511	5:00 - 6:00 PM	8.0%	22.1%	0.361
16 UrbMinArt	658	5:00 - 6:00 PM	8.4%	23.0%	0.366
17 UrbColl	924	5:00 - 6:00 PM	8.6%	23.7%	0.365
19 UrbLocal	477	5:00 - 6:00 PM	8.7%	23.7%	0.369

Table 3. Off-Peak (OP) Period Summary

Functional Class	N	Peak Hour	% Max OP Hr	% OP Per	CONFAC
01 RurInterstate	156	3:00 - 4:00 PM	6.8%	63.3%	0.107
02 RurPrArt	62	3:00 - 4:00 PM	6.8%	58.4%	0.117
06 RurMinArt	86	3:00 - 4:00 PM	6.9%	59.1%	0.117
07 RurMajColl	225	3:00 - 4:00 PM	6.7%	57.6%	0.117
08 RurMinColl	15	3:00 - 4:00 PM	6.7%	56.1%	0.120
09 RurLocal	38	3:00 - 4:00 PM	6.8%	57.1%	0.119
11 UrbInterstate	154	3:00 - 4:00 PM	6.5%	62.3%	0.104
12 UrbFrwy	108	3:00 - 4:00 PM	6.8%	62.9%	0.109
14 UrbPrArt	511	3:00 - 4:00 PM	6.6%	59.2%	0.112
16 UrbMinArt	658	3:00 - 4:00 PM	6.6%	58.4%	0.114
17 UrbColl	924	3:00 - 4:00 PM	6.7%	58.4%	0.115
19 UrbLocal	477	3:00 - 4:00 PM	6.3%	56.7%	0.112

Once each of the 36 CONFAC values were calculated, the three-period CONFAC values were found by a VMT-weighted average of the 12 CONFAC values within each period. Table 4 shows the 36 values and the resulting CONFAC values of 0.39 for the AM, 0.11 for the OP, and 0.36 for the PM peak periods. For example, the AM peak period CONFAC values was VMT-weighted using the following equation:

An example calculation of the AM Peak VMT-weighted CONFAC is provided below.

$$(1,106,804 * 0.370) + (984,564 * 0.397) + (975,650 * 0.380) + (813,091 * 0.402) + (323,349 * 0.427) + (534,907 * 0.407) + (8,677,547 * 0.382) + (1,172,191 * 0.357) + (3,500,387 * 0.380) + (3,807,791 * 0.392) + (1,500,898 * 0.385) + (3,593,913 * 0.405) = 10,443,252.91$$

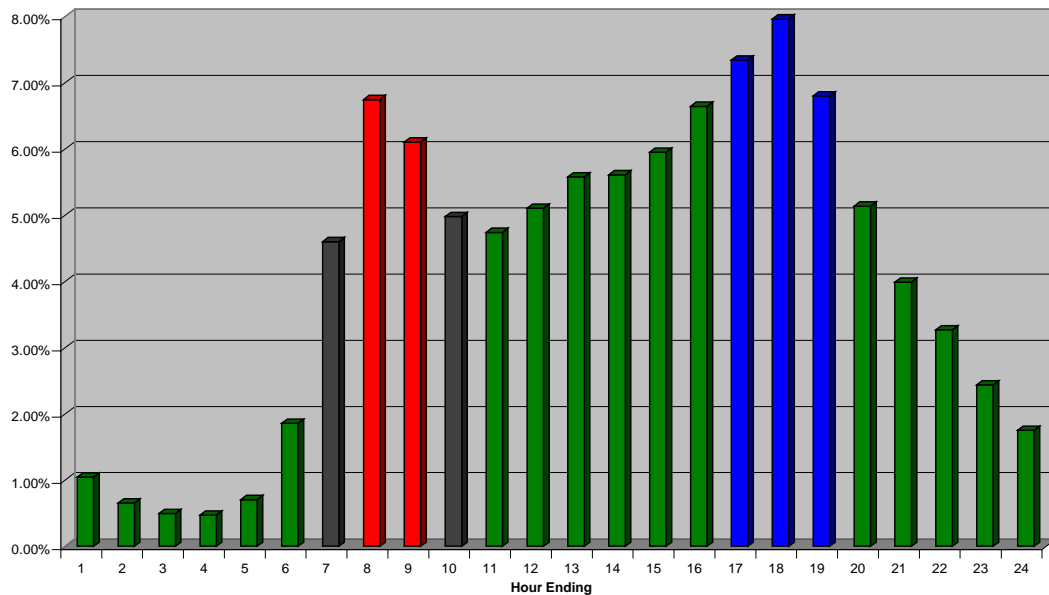
$$10,443,252.91 / 26,991,092 = \underline{\underline{0.39}}$$

Table 4. VMT-Weighted Calculation of Three (3) CONFAC Values

Functional Class	AM VMT	AM CONFAC	OP VMT	OP CONFAC	PM VMT	PM CONFAC
01	1,106,804	0.370	3,339,000	0.107	1,238,550	0.354
02	984,564	0.397	2,499,835	0.117	1,213,940	0.362
06	975,650	0.380	2,125,022	0.117	1,296,404	0.360
07	813,091	0.402	1,898,135	0.117	1,102,905	0.369
08	323,349	0.427	734,584	0.120	447,962	0.384
09	534,907	0.407	1,425,255	0.119	764,578	0.360
11	8,677,547	0.382	26,042,682	0.104	9,920,834	0.357
12	1,172,191	0.357	3,399,182	0.109	1,414,303	0.348
14	3,500,387	0.380	7,584,386	0.112	4,613,730	0.361
16	3,807,791	0.392	8,091,705	0.114	5,258,139	0.366
17	1,500,898	0.385	3,192,549	0.115	2,209,622	0.365
19	3,593,913	0.405	9,205,885	0.112	5,244,127	0.369
All	26,991,092	0.39	69,538,219	0.11	34,725,093	0.36

Based on these findings, three updated values of CONFAC have been determined for use in the emissions post-processor. The AM and PM peak hour values are somewhat lower than the early-1990 values due to system-wide congestion and the shifting of trip starts and ends nearer the shoulders of the peak. The off-peak value is higher since the off-peak maximum hourly volumes are essentially controlled by overflow of the afternoon peak period during the 3:00 to 4:00 PM hour. In other words, the green bars in Figure 1 show the percentage of the 24-hour volume occurring in that off-peak hour. The “16” bar represents 3:00 – 4:00 PM and is an early extension of the PM peak period, representing a spreading of the peak period. This spreading, however, is quantified in the off-peak period and can explain why the off-peak CONFAC has increased to 0.11.

Figure 1. Percent of 1999 Atlanta Nonattainment Area Daily Volumes



Note: The red is the AM peak, the blue is the PM peak and the green is the off-peak. The black bars are the hours sharing AM peak and off-peak.